

SECTION I: STATUS OF SAGE-GROUSE

GEOGRAPHIC DISTRIBUTION

North America

Sage-grouse are native to the sagebrush steppe of western North America. Their distribution closely follows that of sagebrush, primarily big sagebrush (Braun 1998). The species originally occupied portions of 16 states and three Canadian provinces. Sage-grouse presently occur in 11 western states and two provinces, having disappeared from scattered areas around the periphery of its original range, including Arizona, British Columbia, Kansas, Nebraska, New Mexico, and Oklahoma. Much of the species' historical range has been greatly reduced by alteration or elimination of sagebrush habitat (Aldrich 1963) (Figure 1).

North Dakota

The sage-grouse is the largest member of the North American grouse family and second only to the wild turkey in size of all the gallinaceous birds in America. In pioneer times this grouse was the leading upland game bird in nine western states. The species was never widespread in North Dakota and is presently confined to the southwestern portion of the state (Johnson and Kune 1989). The North Dakota population is not isolated but is contiguous with sage-grouse populations in Montana and South Dakota.

Credit for first visual sighting of the sage-grouse has been extended to the Lewis and Clark Expedition. Although these men apparently did not see the bird in North Dakota they did report it in the vicinity of the Marias River in Montana on June 5, 1805. They later reported it to be common west to the plains of the Columbia River.

Unlike sharp-tailed grouse there has been meager prehistoric and historic evidence to suggest that sage-grouse were ever present in North Dakota beyond their present range. Sage-grouse are at the present time limited to southwestern North Dakota where scattered populations are found in three counties; Bowman, Slope, and Golden Valley (Figure 2).

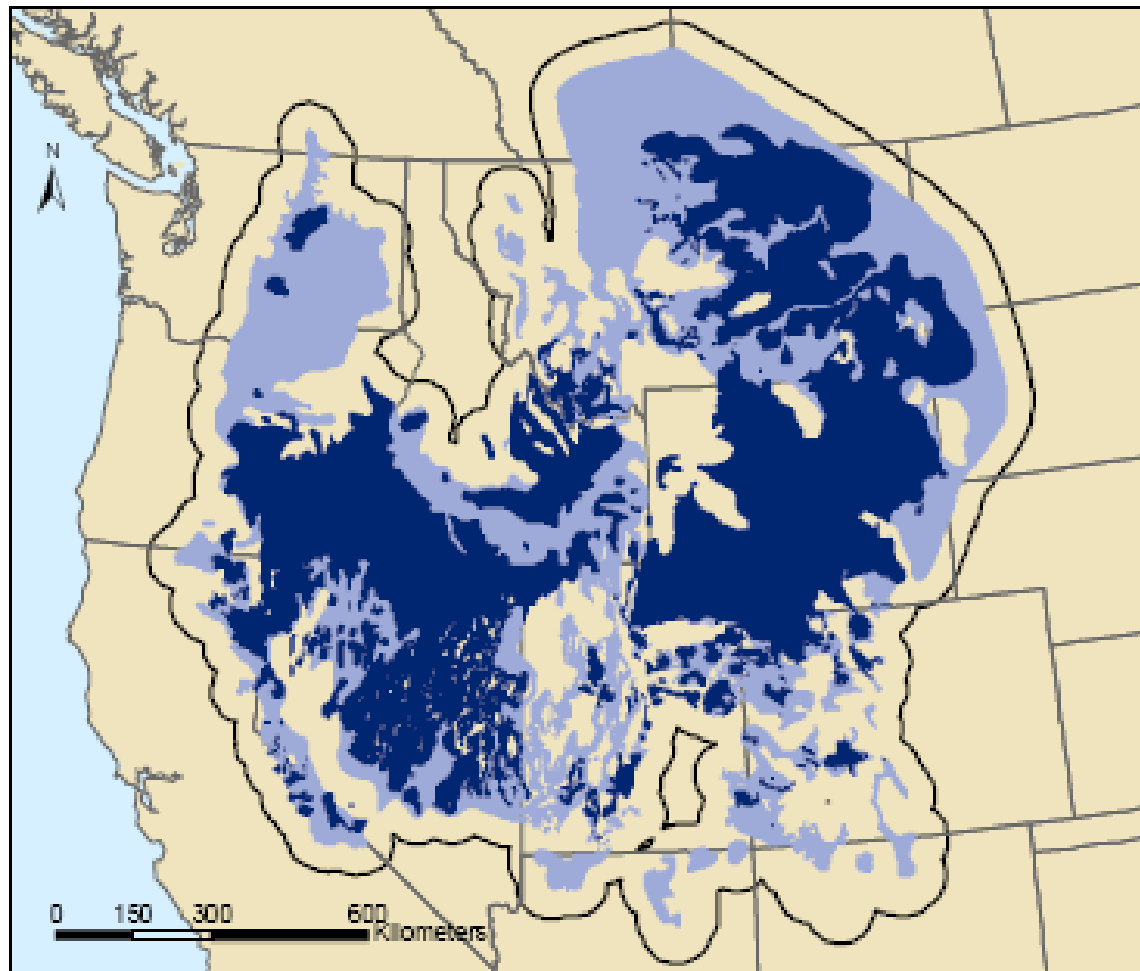
Archeologists report sage-grouse remains have been found at only two of 29 sites where sharp-tailed grouse remains were found in numerous digs made in the Dakotas the past 25-30 years. The two sites where they were found were in the Indian village, Like-A-Fishhook, and the white man's Fort Stevenson military post. Both sites are in McLean County and date from the second half of the 19th century. Based on the sample size of only a few birds at both sites it's highly probable the birds were killed on a hunt farther to the west of both village sites. In the case of the Indian village they may have been killed and their feathers saved to be used on ceremonial fetes (Johnson op. cit.).

Although Audubon himself did not see sage-grouse, members of the 1843 expedition on the Missouri River sighted the bird (Johnson op.cit.)

Over 100 years later Johnson and Knue (1989) in their treatise on upland birds in North Dakota offered their view on the future status of the sage-grouse within the state when they said: "The "cock of the plains" is not destined to become an important game bird in North Dakota. Neither will he ever come under severe criticism by ranchers of the Badlands. Because the wastelands are his element it has been thought he would never be put under stress of habitat destruction. But there is one final reminder which might be kept in mind. Within recent years man has speeded up his efforts to locate new sources of

organic and mineral materials – examples being oil, oil shale, coal, uranium, and copper. Much of this activity is in the western U.S. and where it occurs it has been destructive to sage-grouse and big game habitat. Conservationists must be continually on the lookout for the changes this activity may make on sage-grouse populations.”

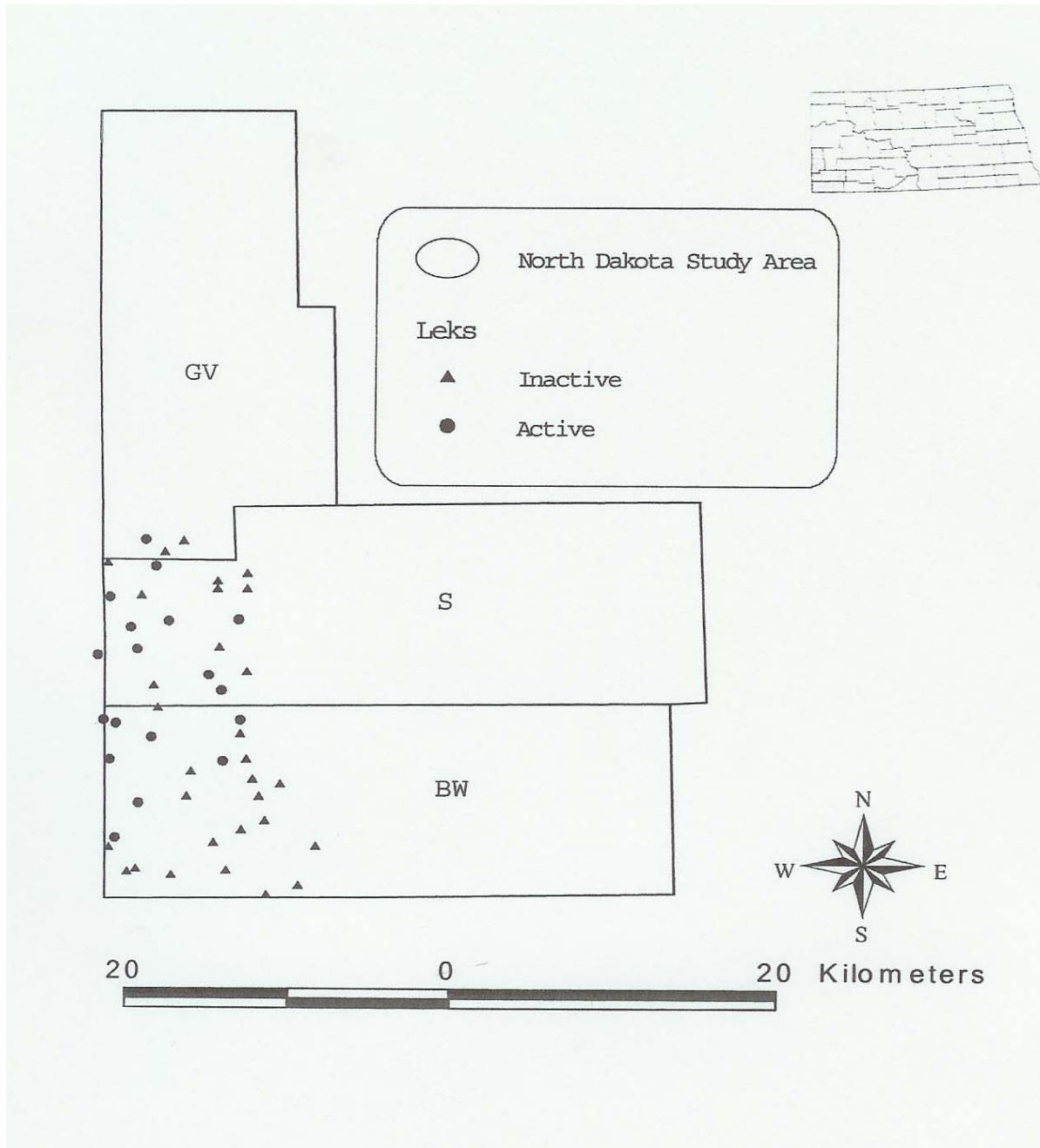
Fig. 1. Current distribution of sage-grouse and pre-settlement distribution of potential habitat in North America (Schroeder 2004). For reference, Gunnison sage-grouse in southeastern Utah and southwestern Colorado are shown.



Pre-Settlement
Distribution of Potential Habitat ■
Current Sage-grouse Range ■

From: Conservation Assessment of Greater Sage-grouse and Sagebrush Habitats, Connelly et al. 2004

Figure 2. Active and inactive leks locations in North Dakota, 2002



From: Smith 2003

Habitat Status

A clear-cut example of the importance of habitat to a wildlife species is illustrated by the life history of the sage-grouse. In North Dakota and other areas of western United States, this grouse is found only where big sage and closely related plants are growing. Many early travelers noted the grouse-sagebrush relationship. Roosevelt wrote that the bird was found “only where the tough, scraggly wild sage abounds, and it feeds for most of the year on sage leaves.” Another early observer, Captain Bendire,

believed the sage plant to be important to the bird but quoted other people who thought the plant important only when other more desirable foods were lacking (Johnson op. cit.).

The bird utilizes the sage plant for both food and cover. Most nests are found in this cover and over 75 percent of its annual food supply comes from the plant. In winter the grouse feeds almost entirely on sage. Young birds in the first three or four months of life feed on insects, but by their first autumn have turned to the plant for their sustenance (Johnson op. cit.). As a result of this diet Johnson also noted that late in the season the flesh of the bird takes on a “sagey tang” which is particularly noticeable in mature grouse. Many early observers believed sage-grouse to be unique because they did not have a gizzard which made their dependence on soft leafy vegetation more important. But, although the organ is relatively undeveloped compared with other game birds, it is present. Since the sage-grouse feed primarily on the herbaceous leaves of the sage plant, and does not require grit in its diet, there is no need for a highly developed gizzard.

The bird is restricted to extreme southwestern North Dakota because big sage is found only in significant acreage in that area. In 1963 a letter from the state’s Dean of Botanists, Dr. O. A. Stevens of North Dakota State University stated:

“The distribution of *Artemisia tridentata* in North Dakota has not changed materially since 1880....I still cannot map it accurately.....It seems to occupy mainly the severely eroded places or sometimes wash from such places; essentially limited to the Badlands, especially the southern part.”

Because sagebrush grows in semi-arid range lands the problems of habitat destruction for this grouse have not been as pronounced as for other species. An example is the sharp-tailed grouse which lives on grasslands that are more susceptible to cultivation and changing land use patterns. Overgrazing by livestock on the rangelands of the western United States was, and is, an important limiting factor on sage-grouse and other game. It was most noticeable in the period 1900-1930’s but during the years 1940 to 1975 it was estimated that in the western states “5-6 million acres of sagebrush range had been treated by burning, spraying, plowing, disking, chaining, cutting and beating in an attempt to convert these ranges to grasslands species” (Western States Sage-grouse Committee 1974).

Smith (2003) believed that loss of habitat for sage-grouse has remained somewhat static since the early 1970’s. In his thesis he states:

“Based on analysis of the current (i.e., 1999) satellite imagery, tilled ground appears to be playing a role in the abandonment of leks in North Dakota. However, when I looked at this relationship, using early satellite imagery (1972-1976) and more recent imagery (1999-2000) there was no increase in the amount of tilled ground associated with the inactive areas since the early to mid 1970’s. If tilled ground is a factor in the abandonment of leks, its effects likely began previous to 1972.”

Since 1980 there has been a slowdown in sagebrush eradication attempts. Much of this is due to a lack of funds from private and governmental sources, plus a stepped-up interest by various conservation-minded groups for protecting all types of wildlife habitat. There is always a possibility of a renewed interest in an eradication program for sagebrush in the future. If it should occur sage-grouse populations in those specific areas could be depleted (Johnson and Knue 1989).

POPULATION DYNAMICS

Winter Population Surveys

From 1946 through 1951, sage-grouse population surveys consisted of observers walking through big sagebrush areas and noting numbers of sage-grouse flushed. This provided a crude index of sage-grouse population numbers on an annual basis. Several large big sagebrush areas in Bowman and Slope Counties were walked annually in winter (usually February) (ND Game and Fish Department Data Files). In addition to the population data, information was recorded on big sagebrush distribution.

Spring Strutting Ground Counts

In 1951 a new method of censusing the birds was initiated. Birds were located and counted while they were on their strutting grounds in March and April. Grounds were located by individuals driving through the sage-grouse range and making periodic listening stops. Some grounds had been located earlier incidental to other work and landowners reported some grounds. Two years later, in 1953, an aircraft was used to locate grounds and make spring counts. Most counts were then made by air until the 1960's when a gradual shift was made from air to ground counts. Today all counts are made from the ground while surveys (searching for grounds) are made by air. Aircraft continue to be used to locate strutting grounds that have moved.

Approximately 17 strutting grounds are censused each spring and numbers of male sage-grouse recorded has varied from 542 in 1958 to 111 in 1996. Over the past twenty-five years (1980 through 2004) total males counted has varied from 111 to 380. The average numbers of males per lek has varied from 32.3 in 1952 to 7.4 in 1996. Over the last twenty-five years the average number of males per lek peaked at 16.6 per ground in 2000 and was at a low in 1996 at 7.4 males. These counts serve as indicators of the size and trend (increasing or decreasing) of the overall population but data are compared on a year-to-year basis for management purposes (Table 1).

The sage-grouse range, within the boundaries determined in 1950 in North Dakota, has been searched by aircraft in its entirety twice in the last 25 years, in 1980 and again in 1999. Prior to 1980 not all sage-grouse strutting grounds had been located, thus trend data from 1980 to the present are more reliable. Data from the past 25 years show a significant decrease in total numbers of males, but not a significant decrease in males per strutting ground (Figure 3). State Game and Fish Department personnel have always conducted the counts but due to shortage of staff and time, counts have been compressed into a one week period, the third week of April. Counts have extended into the fourth week of April when weather disrupted counts during the third week. During all annual surveys each strutting ground is censused at least twice with some being censused three times as time allows. Summing the highest number of males seen on each ground determines the "Total Males" censused for the state (Table 1).

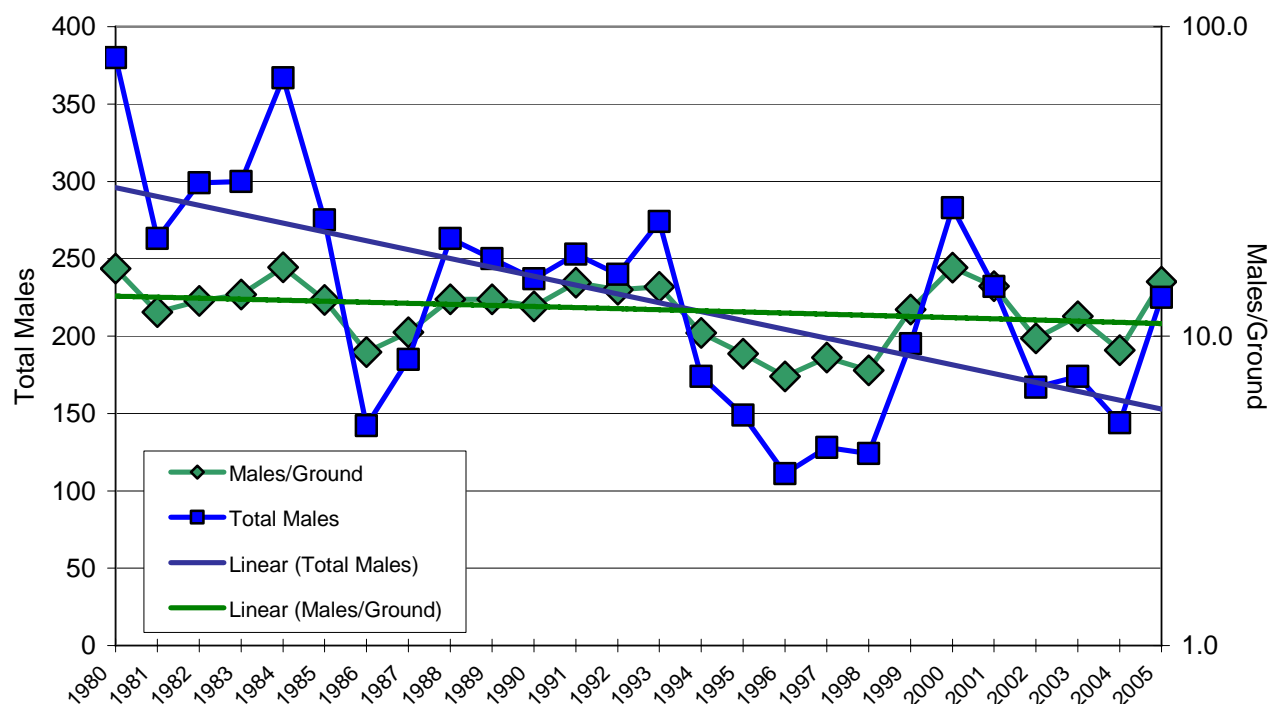
Harvest and Harvest Surveys

During early Dakota territorial and statehood years annual sage-grouse seasons were opened concurrently with sharp-tailed grouse and prairie chickens. As might be expected, early seasons were very liberal. Until 1887 there was no limit on the number of birds that could be taken and until 1890 hunters could hunt all of Dakota Territory which included South Dakota. A limit of 25 was initiated in 1887; the season was reduced from 103 days to 73 days in 1897, and reduced further to 43 days in 1899.

Table 1. Summary of long-term sage-grouse lek surveys in North Dakota, 1951-2005.

YEAR	TOTAL MALES	TOTAL GROUNDS	MALES/GROUND
1951	353	11	32.1
1952	388	12	32.3
1953	542	18	30.1
1954	297	15	19.8
1955	---	---	---
1956	353	18	19.6
1957	251	18	13.9
1958	306	20	15.3
1959	332	20	16.6
1960	---	---	---
1961	255	14	18.2
1962	---	---	---
1963	302	14	21.6
1964	285	18	15.8
1965	204	21	9.7
1966	183	19	9.6
1967	240	17	14.1
1968	236	15	15.7
1969	413	15	27.5
1970	291	17	17.1
1971	277	16	17.3
1972	298	16	18.6
1973	294	17	17.3
1974	270	16	16.9
1975	169	15	11.3
1976	181	18	10.1
1977	213	16	13.3
1978	209	17	12.3
1979	131	13	10.1
1980	380	23	16.5
1981	263	22	12.0
1982	299	23	13.0
1983	300	22	13.6
1984	367	22	16.7
1985	275	21	13.1
1986	142	16	8.9
1987	185	18	10.3
1988	263	20	13.2
1989	250	19	13.2
1990	237	19	12.5
1991	253	17	14.9
1992	240	17	14.1
1993	274	19	14.4
1994	174	17	10.2
1995	149	17	8.8
1996	111	15	7.4
1997	128	15	8.5
1998	124	16	7.8
1999	195	16	12.2
2000	283	17	16.6
2001	232	16	14.5
2002	167	17	9.8
2003	174	15	11.6
2004	144	16	9.0
2005	225	15	15.0

**Figure 3. Summary of Sage-Grouse Lek Surveys
ND 1980-2005**



Daily limits were reduced from 25 to 10 in 1909, and then to 5 in 1917. The season on sage-grouse was closed in 1923.

The sage-grouse hunting season was reopened in 1964 and has been open every year since that time except for 1979. The season in 1988, though scheduled for three days, was only open for ½ day due to an extreme fire danger situation. For the past 20 years, the season has been open three days each year, always opening on Monday and closing on Wednesday with both daily and possession limits being one sage-grouse. The season traditionally opened on the Monday following the opening of the sharp-tailed grouse season; however in 2004 it opened two weeks later to try and reduce the harvest of adult females (ND Game and Fish Department Data Files). The reason for these regulations (short season, one bird limit, week-day season) is to limit hunter participation and thus harvest, while still allowing anyone the opportunity to hunt sage-grouse. This system has been in place since 1964, and has allowed the Game and Fish Department to avoid the cost and work load of conducting a lottery for a very limited number of sage-grouse permits.

Wing data have been collected annually since the season was reopened in 1964. Most wings have been collected by department personnel through contact with hunters in the field but additional wings have been collected through use of wing barrels and a wing envelope survey. From 1964 through 2002, data have been collected on 1,426 sage-grouse wings (Table 2). The small population and Department regulations to restrict harvest results in a very limited sage-grouse wing collection. Numbers of wings collected each year do not provide a large enough sample to make accurate determinations of annual age ratios, sex ratios, and numbers of young per adult hen in either the fall bag or the fall population. The sample of immature wings collected from 1964 through 2002 that could be aged is 701. From these wings a mean hatch date of June 8 was calculated (Table 3).

Table 2. Composition of age and sex classes for sage-grouse, North Dakota 1964-2004.

Year	Adult Males	Adult Females	Immature Males	Immature Females	Total Birds	Age Ratio	Young/ Adult Hen
1964	16 (62%)	4 (15%)	3 (12%)	3 (12%)	26	0.30	1.50
1965	6 (32%)	6 (32%)	3 (16%)	4 (21%)	19	0.58	1.17
1966	2 (6%)	5 (15%)	14 (43%)	12 (36%)	33	3.71	5.20
1967	12 (20%)	20 (33%)	11 (18%)	17 (28%)	60	0.88	1.40
1968	13 (21%)	11 (18%)	19 (31%)	18 (30%)	61	1.54	3.36
1969	15 (23%)	22 (34%)	11 (17%)	16 (25%)	64	0.73	1.23
1970	11 (16%)	18 (27%)	28 (42%)	10 (15%)	67	1.31	2.11
1971	20 (26%)	13 (17%)	20 (26%)	24 (31%)	77	1.33	3.38
1972	20 (17%)	28 (24%)	37 (32%)	31 (27%)	116	1.42	2.43
1973	6 (9%)	27 (41%)	14 (21%)	19 (29%)	66	1.00	1.22
1974	5 (8%)	19 (32%)	10 (17%)	26 (43%)	60	1.50	1.89
1975	21(32%)	17 (26%)	14 (21%)	14 (21%)	66	0.74	1.65
1976	4 (10%)	12 (31%)	13 (33%)	10 (26%)	39	1.44	1.92
1977	13 (62%)	3 (14%)	2 (10%)	3 (14%)	21	0.31	1.67
1978	2 (4%)	19 (41%)	15 (33%)	10 (22%)	46	1.19	1.32
1979	No season						
1980	5 (24%)	15 (71%)	1 (5%)	0	21	0.05	.07
1981	4 (13%)	6 (20%)	13 (43%)	7 (23%)	30	2.00	3.33
1982	5 (12%)	18 (42%)	9 (21%)	11 (26%)	43	0.87	1.11
1983	6 (9%)	20 (28%)	20 (28%)	25 (35%)	71	1.73	2.25
1984	11(22%)	15 (31%)	11 (22%)	12 (25%)	49	0.88	1.53
1985	1 (17%)	1 (17%)	2 (33%)	2 (33%)	6	2.00	4.00
1986	4 (12%)	7 (21%)	10 (30%)	12 (36%)	33	2.00	3.14
1987	3 (17%)	6 (33%)	4 (22%)	5 (28%)	18	1.00	1.50
1988	No wings collected						
1989	6 (22%)	11 (41%)	6 (22%)	4 (15%)	27	0.59	.91
1990	0 (0%)	3 (23%)	2 (15%)	8 (62%)	13	3.33	3.33
1991	5 (31%)	3 (19%)	7 (44%)	1 (6%)	16	1.00	2.67
1992	7 (32%)	7 (32%)	7 (32%)	1 (4%)	22	0.57	1.14
1993	5 (36%)	5 (36%)	2 (14%)	2 (14%)	14	0.40	.80
1994	3 (38%)	2 (25%)	1 (12%)	2 (25%)	8	0.60	1.50
1995	3 (20%)	4 (27%)	6 (40%)	2 (13%)	15	1.14	2.00
1996	3 (11%)	7 (26%)	8 (30%)	9 (33%)	27	1.70	2.43
1997	3 (13%)	6(25%)	6 (25%)	9 (37%)	24	1.67	2.50
1998	4 (14%)	8 (28%)	9 (31%)	8 (28%)	29	1.42	2.13
1999	2 (8%)	8 (32%)	8 (32%)	7 (28%)	25	1.50	1.88
2000	4 (7%)	23 (41%)	14 (25%)	15 (27%)	56	1.07	1.26
2001	2 (10%)	14 (70%)	2 (10%)	2 (10%)	20	0.25	.29
2002	1 (3%)	17 (57%)	6 (20%)	6 (20%)	30	0.67	.71
2003	0 (0%)	3 (38%)	2 (25%)	3 (38%)	8	1.67	1.67
2004	3 (43%)	1 (14%)	2 (29%)	1 (14%)	7	0.75	3.00
Totals	256(18%)	434(30%)	372(26%)	371(26%)	1,433	1.08	1.71

To measure hunter success, post cards are mailed and/or handed out to known sage-grouse hunters prior to the hunting season and are also handed out to all hunters contacted in the field. The post cards request data pertaining to days hunted, area hunted, and success for the entire season (Table 4). While this survey works for measuring hunter success (birds/hunter, days/hunter, and county of harvest), it cannot be used to determine the total number of sage-grouse hunters. To make that determination, a small game hunter questionnaire is mailed to a sample of both resident and non-resident hunters each fall following close of the hunting season. This questionnaire is used to determine total harvest and hunter participation for a number of waterfowl and upland game species, including sage-grouse.

Here again, small numbers of hunters, and few questionnaires from sage-grouse hunters, mean large confidence intervals for number of hunters and total harvest. Estimates over the last fourteen years indicate averages of 124 hunters per year and 47 sage-grouse harvested per year which is a hunter success of about 38%. The harvest is less than 4% of the estimated fall population which falls well below the 10% maximum suggested by Connelly et al. (2000).

Needs

Prior to 2001, no research had been done on sage-grouse in North Dakota. Movements of grouse from leks to nesting and brooding areas is unknown. Movements from summer to winter habitat are unknown and amounts and distribution of nesting, brooding, and winter habitat are unknown. To correct this situation, two research projects were initiated (see Attachment III). Initial efforts at habitat restoration or improvement will center on breeding areas since this is an identified habitat area.

Table 3. The distribution of estimated hatching dates for immature sage-grouse shot during hunting seasons in North Dakota, 1964-2004.

Weekly Period	1964-2004	
	Birds	%
2. May 8-14	1	.1
3. May 15-21	12	1.7
4. May 22-28	59	8.2
5. May 29-June 4	145	20.2
6. June 5-11	165	22.9
7. June 12-18	160	22.3
8. June 19-25	90	12.5
9. June 26-July 2	58	8.1
10. July 3-9	21	2.9
11. July 10-16	8	1.1
Total	719	100.0
Mean	6.47	
Mean Hatch Data	June 8	

Table 4. Sage-grouse hunting statistics collected during sage-grouse seasons in North Dakota, 1991-2004, postcard surveys only.

	91	92	93	94	95	96	97	98	99	00	01	02	03	04
Number of Hunting Parties	26	32	34	41	40	47	57	69	59	61	61	53	74	30
Number of Hunters	47	46	48	46	50	66	92	96	103	108	112	84	122	43
Number of Hunter Days	62	66	86	93	94	108	149	178	174	168	181	143	215	67
Hours Hunted /Hunter/Day	5.4	4.8	5.0	4.8	5.2	5.5	5.8	6.3	6.2	5.2	6.2	5.7	7.1	6.6
Sage-grouse Harvested	18	32	13	12	13	36	33	33	29	58	30	22	15	12
Sage-grouse/Hunter	.38	.70	.27	.26	.26	.55	.36	.34	.28	.54	.27	.26	.12	.28

Reproduction

Due to a limited population in North Dakota, few broods are reported each year, and in some years, no broods are reported. The population simply does not lend itself to any type of brood survey with the exception of reporting incidental brood observations. Not enough of these are recorded in any one year to be meaningful.

Other states with large populations and large wing samples can ascertain reproduction through examination of age ratios from the wing sample. North Dakota wing samples are too small to make these determinations with an average of less than 40 wings per year. Exceptional years, as 1980, when the sample of 21 wings included only one immature (Table 2) can indicate little or no reproduction.

Mortality

Juvenile Mortality – Juvenile mortality during the first few weeks after hatching is typically high, and nearly 40 percent of the young hatched in a given year die by early September (Wallestad 1975). Juvenile mortality rates can increase when drought reduces availability of insects and forbs for food, and important escape cover (herbaceous understory) is limited by poor growing conditions.

Over a 10-year period, Wallestad and Watts (1973) documented an average mortality rate of 56 percent in central Montana from the egg-laying period in April to the opening of the upland bird season in September. This included an average nest mortality of 30 percent and an average juvenile mortality to 1 September of 37 percent. The authors assumed a juvenile mortality rate from 1 September to 1 April (fall-winter) at least equal to that of yearling hens (65 percent) which would yield an annual juvenile mortality rate of 85 percent.

Adult Mortality – Survival rates for adult sage-grouse are generally considered to be high. The following, taken from the Range-wide Conservation Assessment for Greater Sage-grouse and Sagebrush Habitats (Connelly et al. 2004) illustrates this point:

Zablan (2003) estimated survival for 6,021 banded sage-grouse in Colorado using bands recovered from hunters. They estimated survival to be 59.2% (95% CI, 57.1 – 61.3%) for adult females, 77.7% (95% CI, 71.8 – 75.3%) for yearling females, 36.8% (95% CI, 35.4 – 44.8%) for

adult males, and 63.5% (95% CI, 56.9 – 64.6%) for yearling males. They recovered 1 female = 9 years old, 3 females = 8 years old, and 3 males = 7 years old. Females had higher survival than males and adults had lower survival than yearlings. Wittenberger (1978) and Bergerud (1988) suggested that yearling males remain inconspicuous during their first year and thus have a better chance of surviving to adulthood. Male survival was estimated to be 59% in Wyoming (June 1963), 58-60% in Idaho (Connelly et al. 1993, Wik 2002), and 29.6% in Utah (Bunnell 2000). In contrast, female survival was estimated to be 67-78% in Wyoming (June 1963, Holloran 1999), 48-75% in Idaho (Connelly et al. 1993, Wik 2002), 57% in Alberta (Aldridge and Brigham 2001), 60.6% in Colorado (Hausleitner 2003) and 36.8% in Utah (Bunnell 2000).

In contrast, pheasant populations usually have turnover rates that may approach more than 80% annually. Pheasant hen mortality rates greater than 80% have been recorded as a result of severe climatic conditions, predation, and other factors (Dumke and Pils 1973, Warner and David 1982, Perkins et al. 1997).

Predation – Both avian and mammalian predators take sage-grouse. Bullsnares are also considered an effective nest predator in some areas (Montana Sage-grouse Work Group 2004). Predators destroyed 13 percent of known nests on the Yellow Water Triangle in Montana (Wallestad and Pyrah 1974). Nest predators included coyotes (*Canis latrans*), badgers (*Taxidea taxus*), and magpies (*Pica pica*). In the same study, nearly 40 percent of juvenile sage-grouse succumbed to some form of mortality between hatching and early fall, although the proportion attributable to predation was unknown. Golden eagles (*Aquila chrysaetos*) and hawks, including the marsh (*Circus cyaneus*), Swainson's (*Buteo swainsoni*), red-tailed (*B. jamaicensis*), and rough-legged (*B. lagopus*) posed the most probable threat to young birds (Wallestad 1975).

Adult hens are most vulnerable to predation during the nesting period, and low quality nesting cover increases the risk of predation. Adult males are most vulnerable during the spring breeding season while associated with the leks (Wallestad op. cit.). Habitat alterations in the vicinity of leks, especially the construction of power poles or other perch sites for raptors, can affect male survival. Increased perch sites can also affect habitat security in brood rearing and wintering areas. Fragmented habitat may increase predation pressure on adult sage-grouse by forcing birds into more marginal areas for foraging, travel, or roosting. (Connelly et al. 2000)

Dynamics of many predator populations are determined largely by abundance of their primary prey species, which are usually rodents or rabbits rather than grouse (Bump et al. 1947, Angelstam 1986, Myrberger 1988). Environmental conditions that influence changes in primary prey populations, e.g. rodent populations decline as a result of drought, can affect changes in foraging strategies of both mammalian and avian predators, thereby increasing encounters with grouse or grouse nests.

Disease and Parasites – West Nile virus (WNV) was detected for the first time in sage-grouse in Montana, Wyoming and Alberta during late summer 2003 (Naugle et al. 2004). Mosquitoes (especially *Culex tarsalis*) are thought to be the principal vectors of the disease and migratory birds appear to be the major introductory host. The presence of a large sample of radio-instrumented sage-grouse on several research study sites provided an opportunity to detect eight mortalities in Wyoming, four in Montana and five in southeastern Alberta (Walker et al. 2004). Future monitoring will be necessary to document the impact on population trends and the role of the virus in terms of observed mortality rates in subsequent years. Five birds (hunter harvested) in North Dakota tested negative for WNV in 2003 while three sage grouse harvested in 2004 tested negative for WNV.

Simon (1940) described parasites commonly found in sage-grouse in Wyoming. The incidence and infestation of all parasites except the protozoan *Tritrichomonas* was higher in young birds than in adults. Most sage-grouse were infected with tapeworms but exhibited no serious ill effects. He found two species of coccidia that infect sage-grouse, *Eimeria angust* and *E. centroceri*. Outbreaks of coccidiosis may locally decimate populations of sage-grouse.

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